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PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Cages for Ball or Roller Bearings

We, THE SPERRY GYROSCOPE COMPANY LIMITED, a British Company, of Great West Road, Brentford, Middlesex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of manufacturing cages for ball or roller bearings and to cages manufactured by that method.

It is known that the substance polytetrafluoroethylene, (customarily abbreviated to, and hereinafter referred to, as P.T.F.E.), possesses good anti-friction properties but is difficult to machine accurately in the solid form. It is also known to use as plain bearing a body formed of sintered metal whose surface has been impregnated with P.T.F.E. to form the bearing surface.

It is an object of the present invention to provide a method of manufacturing cages for ball or roller bearings which results in a cage in which at least the surface of the cages that are to have frictional contact with the balls or rollers, consist purely of P.T.F.E. pitted all over with evenly distributed minute cavities. In use, the cavities of the cage may retain a lubricant and, as thus used, should have a longer useful life than a cage whose friction surfaces are metal or plain P.T.F.E.

According to the invention, therefore, there is provided a method of manufacturing a cage for ball or roller bearings including the following steps: manufacturing and machining to shape the body of the cage from a piece of high grade sintered metal, impregnating with P.T.F.E. the surface layers of the cage that are to constitute the surfaces that are to have frictional contact with the ball or rollers; machining the said impregnated surfaces until a smooth surface composed of metal and P.T.F.E. is produced; and etching away the surface layers of metal in the said surface of metal and P.T.F.E. by an etching agent that does not attack P.T.F.E. so as to leave surfaces of P.T.F.E. pitted all over with minute cavities as the friction surfaces.

According to another aspect of the invention there is provided a method of manufacturing a cage for ball or roller bearings comprising the following steps: taking a solid compound formed by sintering a mixture of high grade powdered metal and powdered P.T.F.E.; manufacturing and machining to shape a cage from the compound; and etching away the surface layer of metal from the surfaces that are to have frictional contact with the balls or roller by an etching agent that does not attack P.T.F.E., so as to leave surfaces of P.T.F.E. pitted all over with minute cavities as the friction surfaces.

A preferred method of manufacturing a cage falling within the scope of the invention and which has satisfactorily been used in practice, will now be described. The main body of the cage was made from sintered bronze, its function being to provide a support for the P.T.F.E. which, later in the manufacturing process, constitutes the friction surfaces of the cage. It will be appreciated that other metals could have been used, the main requirements being that the metal used should be machinable and resistant to corrosive action by synthetic lubricant. The bronze cage was one that had been sintered from spheroidal powder (as opposed to dendritic) of uniform particle size and free from foreign matter, so that the largest possible proportion of void was achieved. The size of the particles of the powder was such that they could pass through a sieve of 100—150 B.S. mesh. Alternatively, the particles of powder could be such as to be capable of passing through a sieve of 150—200 B.S. mesh.

The machining of the main body of the cage from the sintered bronze was carried out with sharp tools and at a sufficiently high speed to avoid, as much as possible, metal flow at the surface, the comparatively low strength of the

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material being taken into consideration in holding the work and in handling it.

After machining the cage was cleaned by degreasing in xylene and then washed in distilled water.

In order to remove any metal that may have flowed during the machining process, the cage was etched in dilute nitric acid (approximately 5% strength). The cage was then boiled in distilled water to remove the acid and then washed in distilled water. Finally, the cage was vacuum dried.

The step of impregnation of the cage with P.T.F.E. was then performed. A well-known process was used, the procedure being briefly as follows. The cage was suspended within an evacuated vessel over an open container containing an aqueous suspension of P.T.F.E. A material made under the Registered Trade Mark Teflon and known as Teflon 30 was used. An alternative would be that made under the Registered Trade Mark Fluon and known as Fluon HMW 100. The pressure within the container was lowered as far as possible without causing the fluid to froth, this pressure corresponding to a vacuum of approximately 10″ to 15″ of mercury. The cage was then lowered by remote control into the aqueous suspension of P.T.F.E. and the pressure raised to approximately 30 lbs./sq inch and slowly released. The penetration of P.T.F.E. into the sintered bronze depends on the variations in pressure during the process. With the pressures referred to, a penetration of .030″ to .040″ was achieved. The cage was then removed from the fluid and suspended so as to enable the surplus fluid to drain off, after which it was dried under vacuum. This part of the process is critical and should be done slowly to avoid boiling the water and ejection of the suspension. The vacuum was gradually increased as the drying proceeded.

The dried out cage was placed on a trivet in an electric furnace, heated to a temperature of 380°—400° C. Since the melting point of P.T.F.E. is 325° C. this temperature range gave a reasonable margin and allowance for the thermal capacity of the cage The heating time was of the order of 15 minutes. It will be appreciated, of course, that the heating time will depend on the mess and surface area of the cage. The cage was removed from the oven when the P.T.F.E. was fused.

The cage thus produced was covered by an irregular but continuous film of P.T.F.E. This was removed from the friction surfaces by machining. It could, of course, be scraped off. Also, the continuous film could be removed from all the cage. In the process of machining, some of the surface metal of the friction surfaces was also machined off, leaving a surface of P.T.F.E. and metal. The cage was degreased and washed in distilled water and then etched in dilute nitric acid (for example 5% strength) in order to remove the metal to a depth of about .001″ below the original surface. This gave the new surface the appearance of a thick walled honeycomb with shallow cavities of .001″ and about .004″ diameter.

Although the P.T.F.E. is itself self-lubricating, it is preferable that friction surfaces of a cage made in accordance with the method of the invention should be used as carriers for a lubricant. The advantage of having P.T.F.E. rather than sintered bronze or other metal as the carrier for the lubricant is partly that it itself has a lower coefficient, and partly that the properties of P.T.F.E. as a lubricant in itself provide a factor of safety in the case of temporary failure of the oil lubricant. The cage will have a longer useful life than a cage whose friction surfaces are plain P.T.F.E. or metal.

An alternative method of making a similar cage would be to procure a compound of sintered metal, such as bronze, and powdered P.T.F.E., make a cage from it, and etch the surfaces that are to constitute the friction surfaces, as in the previously described embodiment. Some of the steps of the previous method, such as cleaning and degreasing, would, of course, also be used as necessary.

What we claim is:—

1. A method of manufacturing a cage for ball or roller bearings including the following steps: manufacturing and machining to shape the body of the cage from a piece of high grade sintered metal; impregnating with P.T.F.E. the surface layers of the cage that are to constitute the surfaces that are to have frictional contact with the balls or rollers; machining the said impregnated surfaces until a smoth surface composed of metal and P.T.F.E. is produced; and etching away the surface layers of metal in the said surface of metal and P.T.F.E. by an etching agent that does not attack P.T.F.E. so as to leave surfaces of P.T.F.E. pitted all over with minute cavities as the friction surfaces

2. A method as claimed in Claim 1 wherein the surface layers are etched to such an extent that the depth of the cavities is of the order of .005″ to .001″.

3. A method as claimed in Claim 1 or Claim 2 wherein subsequently to the etching process the P.T.F.E. is stabilised by heating the cage to a temperature of approximately 200° C.

4. A method as claimed in any one of the preceding claims wherein the step of impregnating the surface layers with P.T.F.E. involves vacuum impregnation to ensure penetration.

5. A method as claimed in any one of the preceding claims wherein the sintered metal selected is one that has been formed from a powder whose particles will pass through a sieve of 100—150 B.S. mesh.

6. A method as claimed in any one of the preceding Claims 1—4 wherein the sintered metal selected is one that has been formed

from a powder whose particles will pass through a sieve of 150 to 200 B.S. mesh.

7. A method as claimed in any one of the preceding Claims 1—6 comprising the step of cleaning the said surface of the metal body by degreasing, for example, by means of xylene, and washing in distilled water prior to impregnation.

8. A method as claimed in any one of the preceding claims comprising the step of etching said surface layers of the metal for example, by etching in dilute nitric acid, prior to the impregnation step to remove the metal that has flowed due to machining.

9. A method as claimed in Claim 8 comprising the additional steps of boiling the metal body in distilled water and washing it in distilled water prior to impregnation.

10. A method as claimed in any one of the preceding Claims 7—9 wherein the metal, after cleaning, and prior to impregnation, is vacuum dried.

11. A method as claimed in any of the preceding claims in which the etching agent is dilute nitric acid.

12. A method of manufacturing a cage for ball or roller bearings comprising the following steps: taking a solid compound formed by sintering a mixture of high grade powdered metal and powdered P.T.F.E.; manufacturing and machining a cage from the compound; and etching away the surface layers of metal from the surfaces that are to have frictional contact with the balls or roller by an etching agent that does not attack P.T.F.E. so as to leave, as the friction surfaces, surfaces of P.T.F.E. pitted all over with minute cavities.

13. A cage for ball or roller bearings made in accordance with the method claimed in any one of the preceding claims.

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PROVISIONAL SPECIFICATION

Cages for Ball or Roller Bearings

We, THE SPERRY GYROSCOPE COMPANY LIMITED, a British Company, of Great West Road, Brentford, Middlesex, do hereby declare this invention to be described in the following statement:—

This invention relates to a method of manufacturing cages for ball or roller bearings and to cages manufactured by such method.

It is known that the substances known generally as polytetrafluoroethylene, customarily abbreviated to P.T.F.E., possesses good anti-friction properties, but it is difficult to machine in the solid form. It is known also to form a compound by sintering a mixture of powdered metal or metal alloy and powdered P.T.F.E. This compound is suitable for machining and is available on the market.

It is an object of the present invention to provide a method of manufacturing cages for ball or roller bearings in which at least the friction surfaces of the cages consist purely of P.T.F.E.

According to the invention a method of manufacturing a cage for ball or roller bearings consists in manufacturing and machining a cage to shape from a known sintered compound formed of powdered metal or metal alloy and powdered P.T.F.E. and subsequently etching the cage to dissolve out the metal in the surface layers or at least in the surface layers of the friction surfaces by an acid that does not affect the P.T.F.E.

By this method a cage is produced whose surface layers or friction surface layers consists of P.T.F.E. free of metal.

The invention also consists in a cage for ball or roller bearings made by the method described.

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